

WHAT IS CLAIMED IS:

1. An engine starter system<sup>1</sup> for starting an engine, comprising:  
a starter motor<sup>0</sup> having an armature<sup>11</sup> for generating rotation force;  
a pinion<sup>3</sup> movable to transmit the rotation force from the armature  
to a ring gear<sup>20</sup> of the engine;  
a solenoid switch<sup>2</sup> including an exciting winding<sup>8</sup> and a plunger<sup>9</sup>,  
the plunger being for engaging the pinion with the ring gear by pushing  
the pinion, and the exciting winding being for moving the plunger  
using magnetic force generated by energizing the exciting winding;  
a first energizing circuit including a current switching device<sup>4</sup>  
connected to the armature in series, for energizing the armature  
by turning on the current switching device;  
a second energizing circuit including a relay<sup>5</sup> with relay contact  
points<sup>5a</sup> connected to the armature in series, for energizing the armature  
by closing the relay contact points; and  
an electronic control circuit<sup>6</sup> for controlling an operation of  
the current switching device and an operation of the relay contact  
points.
2. The engine starter system according to claim 1, wherein the  
current switching device is connected in a wiring at any one of a  
higher voltage side<sup>Fig. 1</sup> of the armature and a lower voltage side<sup>Fig. 2</sup> thereof.
3. The engine starter system according to claim 1, wherein the  
electronic control circuit is constructed to control the operation  
of the current switching device and the operation of the relay contact  
points according to engine starting modes, the modes including a

normal starting mode where the engine is started by turning on a key switch and an economy-running starting mode where the engine is automatically started when a predetermined condition is satisfied without turning on the key switch.

4. The engine starter system according to claim 1, wherein the electronic control circuit is constructed to energize the armature by turning on the current switching device when the engine is started and gradually increase a current flowing through the armature.

5. The engine starter system according to claim 1, wherein the electronic control circuit is constructed to close the relay contact points when a current flowing through the current switching device becomes larger than an allowable current value of the current switching device.

6. The engine starter system according to claim 5, wherein the electronic control circuit is constructed to determine a time of closing the relay contact points based on at least one of time passing after turning on the current switching device, the current flowing through the armature, a rotation speed of the engine and a rotation speed of the starter motor.

7. The engine starter system according to claim 1, wherein the electronic control circuit is constructed to stop energizing the solenoid switch after opening the relay contact points at a time of stopping energizing the armature.

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8. The engine starter system according to claim 1, wherein the electronic control circuit is constructed to turn off the current switching device and open the relay contact points when predetermined time passes after turning on the current switching device.

9. The engine starter system according to claim 1, wherein the solenoid switch has no inside contact points through which the armature is energized.

10. The engine starter system according to claim 1, wherein the electronic control circuit is constructed to repeatedly turn on and off the current switching device with a varying duty ratio to vary a current flowing through the armature.

11. A method of starting an engine comprising the steps of:

supplying a current to an armature of a starter through a current switching device with a varying duty ratio, which gradually increases the current; and

supplying the current to the armature through relay contacts of a relay connected in parallel with the current switching device, when a predetermined condition is satisfied.

12. The method as in claim 11, wherein the predetermined condition includes at least one of time passing after turning on the current switching device, the current flowing through the armature, a rotation

speed of the engine and a rotation speed of the armature.

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